The Newsletter of the Earth Sciences Directorate

Earth Sciences NEWS

NASA Goddard Space Flight Center

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Good Times in the Past and Exciting Times Ahead

— Dr. Vincent Salomonson

It has been a hectic last few months for all of us in Code 900. Some of the major activities or events that have been impacting the Directorate include: the evolving Centerwide reorganization (see the Project Goddard homepage for details), the retirement of Dr. Lou Walter (Associate Director of the Directorate—see article on page 8), continued work on the Directorate Strategic Implementation Plan, continued evolution in NASA's Earth Sciences Program (ESP), and a wide variety of successes and accomplishments in the Directorate's science, technology, education, and outreach efforts, including the successful flight of SeaWiFS and (so-far) the Tropical Rainfall Measuring Mission (TRMM), and exciting and provocative returns from the Mars Global Surveyor, indicating that the Mars Orbiter Laser Altimeter (MOLA) instrument is working very well.

You all know by now that the Center is in the process of evolving a new organizational structure from Codes 500 and 700 and other elements of the Center, including Codes 900 and 600, into, principally, a Systems Technology and Advanced Concepts Directorate (STAAC) and an Applied Engineering and Technology Directorate (AETD). What does

(Continued on page 3)

Inside this issue

NASA's Earth Sciences Program Exhibit to Open

There is a world of changes underway at the GSFC Visitor Center

Most of the south wing of the GSFC Visitor Center is being transformed into a new and exciting Earth Sciences Program exhibit, due to open in January, 1998. The GSFC Public Affairs Office is working with several GSFC groups, NASA Headquarters, and the National Oceanic and Atmospheric Administration's National Weather Service (NWS) to bring the story of NASA's Earth Sciences Program and Earth system science to the general public.

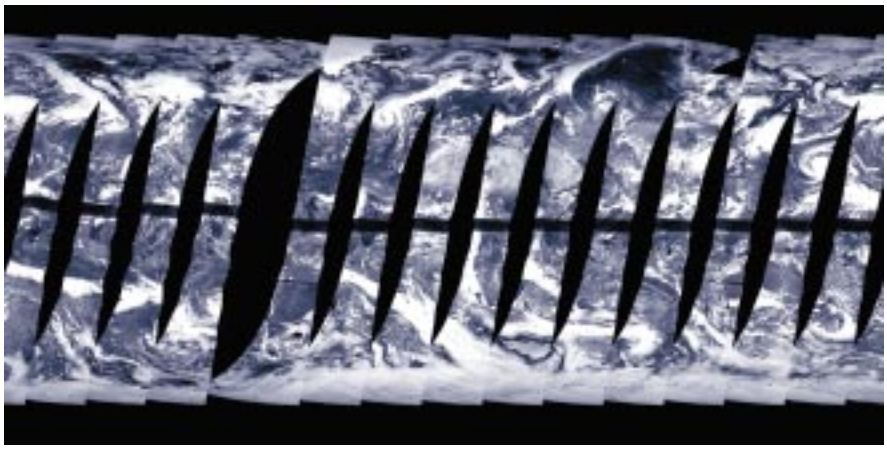
The exhibit will allow visitors to use state-of-the-art technologies as they guide themselves through displays that will let them see what kinds of questions scientists and policy-makers have about the Earth, how NASA and other organizations are working to answer those questions, and what can be done with the information and knowledge gained from this Program.

The exhibit is being designed to show the interconnectedness of the Earth's systems, and that the Earth is constantly changing. Earth colors and sounds will pervade the exhibit and add to the experience. A new Science Visualization Theater will show short "stories"

(Continued on page 7)

SeaWiFS Releases the First Global Ocean Color Data and Images

by Grey Valenti



The Sea-viewing Wide Field-of-view Sensor (SeaWiFS) Project (in the Laboratory for Hydrospheric Processes) released the first global ocean color data and images from the satellite that will be used both to research El Niño and global warming, and perform environmental monitoring, such as tracking oil spills and sources of potential cholera outbreaks.

SeaWiFS was launched at noon (PDT), August 1, 1997, from Vandenberg Air Force Base into a low-Earth orbit onboard an extended Pegasus launch vehicle. After one month of orbit raising, and a few weeks of test data, SeaWiFS is providing the first readily available ocean color data in over ten years and the first continuous look at the global biosphere ever.

"The images are more than we ever could have hoped for," said the SeaWiFS data processing lead, Dr. Gene Feldman. "Although originally designed to just study the oceans, we've also discovered a way of using it to study the land as well, and as a result, we can study the 'global biosphere' for the very first time."

Ocean color is determined largely by the concentration of microscopic marine plants called phytoplankton. Accurately quantifying phytoplankton concentration plays a major role in El Niño and global warming research, as well as in local concerns such as fisheries.

SeaWiFS also offers great potential for monitoring oceanic conditions that have serious, and often tragic, effects on human health. Coastal blooms of algae have been associated with cholera outbreaks around the world. Early detection of these blooms, and subsequent in-water sampling, may significantly reduce the impact of these outbreaks. Red tides, ocean dumping of organic and chemical waste, and perhaps even oil spills can be tracked with SeaWiFS data, Feldman said.

With SeaWiFS, NASA is leading an international collaboration. Over 300 scientists representing 35 countries have already registered to use the data. There are 38 groundstations spread over 18 countries starting to receive the data.

NASA also has developed a software package called the SeaWiFS Data Analysis System (SeaDAS) for scientists worldwide to process the data. Over 150 scientists have already been to NASA to learn to use this package. Another 100 scientists from 11 countries attended SeaDAS training this October.

Unlike most NASA missions, the SeaWiFS Project described the data it wanted to purchase without giving specific requirements for the spacecraft itself. "It's a whole new way of doing business," said SeaWiFS Project Manager, Dr. Mary Cleave.

The SeaWiFS instrument was built by Hughes/Santa Barbara Remote Sensing and is the only scientific payload on the OrbView-2 spacecraft, developed by Orbital Sciences Corporation, Fairfax, VA. NASA is buying the data to provide it to researchers throughout the world.

SeaWiFS is a follow-on sensor to the Coastal Zone Color Scanner (CZCS), which operated aboard NASA's Nimbus-7 satellite from 1978-1986 and proved that satellite sensors could detect ocean color from space. SeaWiFS improves on CZCS by giving global coverage every 48 hours, giving a more accurate determination of phytoplankton concentration, and giving an improved atmospheric correction scheme. SeaWiFS images, data, and the SeaDAS software package are available from the World Wide Web at http://seawifs.gsfc.nasa.gov/SEAWIFS.html.

(Continued on page 13)

Good Times in the Past and Exciting Times Ahead

(Continued from page 1)

this mean to us? Such a reorganization will mean more than simply assigning people to new codes. Goddard is seeking to implement a matrixed, more team-oriented, and customer-focused way of fulfilling our mission. How does this affect Code 900? After all, we already work in teams and we have been increasing our customer focus for a few years now. We even have outreach and customer focus concentrations in our performance plans. In reality, there may not be much change at the day-to-day level, but it, of course, has significance for the long-term future. It is very clear that our Center Director, Joe Rothenberg, has clearly seen the need and importance of these changes taking place, and the intents and purposes are for the best interests of the Center employees and Goddard overall. Code 900's responsibility in this context, and in general, is to provide the required and expected science leadership and resources to ensure that Goddard retains its identity as a Center of Excellence for scientific research. Therefore, we need to support the Center Director and attendant decisions and agreements as and when they happen, with the goal of Code 900 setting the appropriate example at every step along the way.

Under the leadership of Dr. Dot Zukor, Deputy Director of the Directorate, good progress has been made on the Directorate Strategic Implementation Plan. The Directorate plan carefully follows the Center plan, but adds a wide array of actions and performance measures that are Directorate specific. This plan has been put on the Directorate homepage for guidance to all Directorate employees in planning and adapting their activities for the future. The homepage publication of the plan will invite comments and suggestions. The Directorate plan must evolve and be revised or updated at least annually to be more attuned to realities or changes not known or expected at the time this present version was written. Much of that revision activity will depend on the comments and suggestions received regarding the present plan.

This summer, NASA's Earth Sciences Program Office conducted the first Biennial Review of the program to determine the future path of ESP and Earth science at NASA. This review as well as other developments indicate that we in the Directorate not only need to continue excellence in the science that we do, providing needed input to the inescapable evolution and revision of the ESP in the near future. In addition, we need to be agile and creative in articulating the practical spin-offs of the science we do and to watch for, or develop, opportunities to communicate effectively with the public about the benefits of ESP efforts and enhance educational efforts to improve scientific literacy. From a somewhat different perspective, we must all learn to think in terms of input, output, outcome, and impact. Input involves the resources put forth to sustain research or projects that usually are in the form of dollars or personnel. Output might be the number of peer-reviewed papers our research produces, the data products produced, etc. Outcome in this context has to do with the new insights and understanding provided for science as measured by citation indices, or even concise summaries of new knowledge gained. Impact is meant to measure (as the word indicates) the results of the research in the form of concrete, practical applications or use by private industry, government agencies, or the citizenry at large.

We have had many good things that have been accomplished in the last few months. It is impossible for me to note all of them and express the appreciation that I feel for all the good work that is occurring. I will take this opportunity to single out some mission accomplishments. The MOLA on the Mars Global Surveyor has been in the process of gathering some exciting and very intriguing information about the topography of Mars. The whole MOLA team deserves kudos for many accomplishments leading to this attainment. We have seen some excellent results from the recent SeaStar/OrbView-2 launch, and the whole Goddard team including Mary Cleve, Chuck Mclain, and Gene Feldman and their collaborators throughout the Directorate are to be congratulated for the fine work that was and is being done. The TRMM launch has occurred and everything looks very good so far (as of early December). Again, congratulations to Joanne Simpson, Kris Kummerow, and all their collaborators in the Directorate, the TRMM Project and throughout the Center. Check out the homepages of both projects for updates.

Finally, it seems important to note that the next few months and the next year are going to be very interesting. Simply expressed in the form of upcoming launches, one can see something of the excitement to come. Most notably, the launches of EOS AM-1 and Landsat will occur in the middle of 1998. We will have opportunities to propose, and hopefully win, new research efforts in the Code Y (NASA's Earth Sciences Program) arena (e.g., the Instrument Incubator program and the Earth System Sciences Pathfinder-ESSP opportunities), as well as several in Code S (Space Sciences), where Directorate capabilities would be relevant. So, let's keep doing as well or better than we have been doing in the past with

(Continued on page 10)

A Very Bad Boy

The Phenomenon

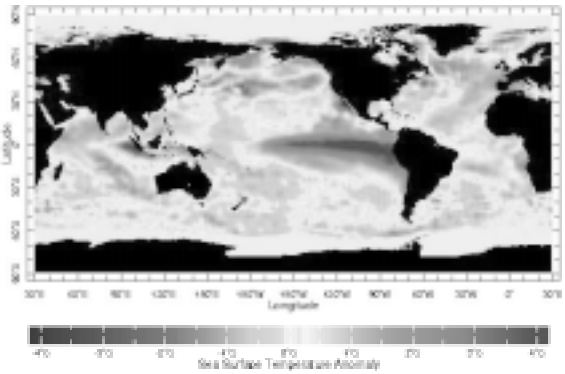
It sounds so benign: "El Niño," Spanish for "The Boy Child."

But we know that El Niño is anything but benign—at least, as far as what it portends for the Earth's biophysical climate system.

About every three-to-five years, a pool of warm water begins to move eastward from the western Pacific Ocean, taking up residence off the western coast of South America. Because the process reaches its peak around Christmas, Peruvian fishermen have taken to calling this phenomenon El Niño. The warming waters cause moisture-laden air to rise, weakening, halting, or even reversing the southeast trade winds that normally carry rainclouds westward from the coast of South America to Australia and beyond. The local effects on fisheries are profound: The influx of warm water overlays nutrient-rich colder waters. Fish in the area, no longer finding fertile feeding grounds, move elsewhere in search of sustenance. The fishermen, as a result, find fewer and fewer fish. Local economies suffer, and the first effects of El Niño on people are felt.

El Niño is now known to disrupt weather patterns around the globe, causing droughts in some areas and floods in others. The usual result is extremely dry weather in eastern Australia, Indonesia, and elsewhere, extremely heavy rainfall down the west coast of South America, displacement of heavy monsoon rain systems over Asia, and crop-withering drought in other parts of South America. Floods ravaged the west coast of North America during the last major El Niño, and drought caused starvation in southern and eastern Africa.

A recent El Niño may have contributed to the Mississippi River basin floods of 1993 and the California floods of 1995. The last strong El Niño, in 1982-1983, which was the worst in 100 years, brought with it freak weather that caused damage in 15 countries estimated at $13 billion and killed 2,000 people.



Monthly mean sea surface temperature anomaly (blended from ship, buoy, and bias-corrected satellite data).

Predictions and Research

In the past year, scientists at Goddard and elsewhere used complex computer-based models to predict the onset of yet another El Niño—one that would be stronger than any other in recent history.

"This El Niño event is taking everyone by surprise," according to Dr. Tony Busalacchi, Chief, Laboratory for Hydrospheric Processes, Code 970. "The surprise comes from the amplitude of the sea-surface temperature changes, and the rapidity of their onset."

Oddly, the computer model with the best and longest track record, the Cane-Zebiak model, did not predict this year's El Niño. The Cane-Zebiak model is classified as an intermediate model, with simplified physics for the ocean and the atmosphere. Busalacchi isn't sure if the coupled global circulation models (GCMs) were successful due to more complicated physics, or better initialization using recently obtained tropical ocean data.

Regardless, the Predictions Are Coming True.

Drought blamed on El Niño is affecting farmers in New Zealand and Australia, and already has forced a copper giant to stop shipments from its Papua New Guinea mine because there is not enough water in the rivers used by shipping barges. Livestock and crop yields will suffer due to colder, drier weather. The new weather patterns are threatening the coffee crop in Indonesia and rice, corn, and coconut crops in the Philippines. On the other side of the Pacific, flowers are blooming in the Chilean desert after downpours that soaked the country, and unexpected snowfalls have trapped travelers in Andean passes.

Rio de Janeiro experienced its hottest winter day in 75 years in September 1997, with temperatures rising to 42

(Continued on page 5)

degrees Celsius (108° Fahrenheit). Brazilian meteorologists attribute this to the onset of El Niño.

Southern China suffered record floods, with crop and property damages in the range of tens of millions of dollars, while northeastern China was afflicted by the worst drought in the century, causing major river basins to dry up and forcing local governments to impose severe water rationing.

Anglers in northern California are hauling in mahi mahi, swordfish, marlin, sardines, and other fish rarely seen in the usually cold waters between Monterey and the Farallon Islands, where recent surface water temperatures have been as much as eight degrees Fahrenheit above normal. Farther north, off the Washington coast, two men landed a 104-pound marlin, the first such catch ever recorded in the area. Marlin seldom stray north of the southern Baja Peninsula.

There are occasional benefits, however. The current El Niño has spawned a summertime pattern of low pressure, tropical moisture, and lower temperatures, which have combined to help reduce Southern California smog, a byproduct of heat and stagnant air. Air quality officials said 1997 could prove to be the most smog-free year in the 40 years measurements have been taken.

Goddard's Role

In a series of continuing efforts to further refine predictive models, GSFC has been given authority by NASA Headquarters to start the NASA Seasonal-to-Interannual Prediction Project (NSIPP). The main goals of the NSIPP are to demonstrate the utility of satellite data, especially altimeter and air/sea flux observations, in a coupled model prediction system to assess the role of satellite data as part of a global observing system. It will also aid in the design of the observing system for short-term climate prediction by conducting observing system simulation experiments and predictability studies. "We're no longer looking at just the atmosphere-ocean coupling," says Dr. Michele Rienecker, who is working with the NSIPP, "but land surface modelers and the Data Assimilation Office at Goddard are also involved."

The project specifically targets the assimilation of satellite data into a coupled atmosphere/ocean/land/ice modeling system (developed at GSFC) to predict not only the short-term climate variations associated with sea-surface temperature variations in the tropical Pacific, but also those processes and teleconnections that have socioeconomic impacts on the United States.

NSIPP will use data from the TOPEX/Poseidon altimeter, space-based estimates of surface wind fields (originally derived from NASA Scatterometer data on the now-defunct Japanese ADEOS satellite, but now obtainable from SSM/I data), data from the Tropical Rainfall Measuring Mission, and upcoming Earth Observing System observations to develop an experimental short-term climate prediction capability for ESP's Seasonal-to-Interannual Climate Variability and Prediction Program.

In addition to the NSIPP, Code 910, the Laboratory for Atmospheres, is carrying out a parallel effort under the ESP EOS/Interdisciplinary Investigation Program, using modeling and diagnostic studies of El Niño and related climate phenomena, global climate models in conjunction with remote sensing data, and *in situ* observations and four-dimensional assimilated data. These efforts include studies on the mutual impacts of El Niño and the monsoon systems of Asia and South America; relationships between El Niño and interdecadal and longer term climate variability, and the development of an end-to-end regional simulation and prediction system for El Niño-afflicted regions. "We are leaving no stones unturned in trying to understand and predict El Niño and its global consequences," says Dr. William Lau of Code 913, the Climate and Radiation Branch.

For years the community at large has focused on physical climate data such as those described above. But El Niño is also potentially catastrophic for marine ecosystems, and biological data should provide new possibilities for understanding the effects of El Niño on marine biosystems.

Biological data will be made available by the successful launch of the Sea-viewing Wide Field-of-View Sensor, SeaWiFS. SeaWiFS is a follow-on to the successful Coastal Zone Color Scanner (CZCS), which was launched on Nimbus-7 in 1978 and which ceased operation in 1986 after providing a wealth of ocean-color information. SeaWiFS will provide quantitative data on global ocean bio-optical properties, a measure of the types and quantities of marine phytoplankton. Busalacchi says that "SeaWiFS can give us a handle on year-to-year changes in primary production, which can be incorporated into coupled models," augmenting the physical climate data now being used.

GSFC, as NASA's lead center for the NASA Earth Sciences Program, is once again at the forefront of Earth system science activities—and the staff in Code 900's laboratories is leading the way.

Dr. Mitchell K. Hobish

Adios to ADEOS

The design and implementation of the components necessary to study the Earth as a single, complex environmental system are so vast that no one nation or organization can undertake the task successfully. Given the enormous expense, time, and energy that go into creating such complex systems, there is little opportunity to provide redundancy of resources.

So, what, then, do we do when a piece of system is no longer serviceable?

That's the question being faced by NASA and other Earth science data- and information-sharing organizations around the world as they come to grips with the loss of Japan's Advanced Earth Observation Satellite (ADEOS), also known as *Midori*.

ADEOS was built by the Mitsubishi Electric Co. for Japan's National Aerospace Development Agency (NASDA). This 4 x 4 x 5-m bus satellite, with a 3 x 26-m solar array, was launched on August 17, 1996 from the Tanegashima launch facility on an H-2 booster. The satellite was designed for a 797-km, Sun-synchronous polar orbit (98.6° inclination) with a 10:30 a.m. equatorial crossing time; it would provide a 41-day repeating ground track.

The main objective of ADEOS was to explore the Earth system by integrating several geophysical parameters, derived from data obtained by several instruments. The main parameters generated by ADEOS were the energy flux between the atmosphere and the ocean; the three-dimensional distribution of temperature and water vapor; the distribution of aerosols over the ocean; chlorophyll distribution in the ocean; sea surface temperature; ocean wind vectors; and vegetation distribution.

In addition, the data acquired by ADEOS could be used for applications such as weather forecasting, probing of fishing grounds, land cover surveying, and elevation measurement.

The payload was a model for NASA's Earth Sciences Program flights, with seven instruments, provided by different nations and organizations: AVNIR (Advanced Visible and Near-Infrared Radiometer), provided by NASDA; ILAS (Infrared Limb Atmospheric Spectrometer), from Japan's Environmental Agency; IMG (Interferometric Monitor for Greenhouse Gases), from Japan's MITI; NSCAT (NASA Scatterometer), from NASA; OCTS, the Ocean Color Temperature Scanner, from NASDA; POLDER (Polarization and Directionality of the Earth's Reflectance), from CNES; RIS (Retroreflector in Space), from Japan's Environmental Agency; and TOMS, a Total Ozone Mapping Spectrometer (from NASA).

After a series of initial activation and check-out glitches, ADEOS performed well for some 42 weeks. Of particular interest to NASA scientists were the data acquired from NSCAT. These data were of tremendous significance for investigators examining wind speed and patterns along the ocean surface. To date, these data have already been used in models to help predict the path of tropical storms and hurricanes, and also to identify the onset of a new El Niño event off the coast of South America.

The TOMS instrument provided data on the amount of ozone in the Earth's atmosphere. "The ADEOS spectrometer, along with the TOMS Earth Probe (EP) instruments . . . observed the unusual loss of Arctic polar ozone reported earlier this year," said GSFC's Dr. Arlin J. Krueger, Principal Investigator and Instrument Scientist for TOMS/ADEOS.

Then, on June 30, 1997, NASDA announced that it was unable to receive the X-band observational data from ADEOS scheduled for acquisition at 9:46 (Japan Standard Time — JST) by the Earth Observation Center at Hatoyama, Saitama prefecture. Analysis of the tracking data showed that the satellite had lost its proper attitude once, and that the solar panel was supplying no voltage. Telemetry data received later by the Okinawa tracking station indicated that the satellite had lost attitude control and that the solar arrays were supplying no power.

Subsequent attempts to confirm the satellite's status showed no telemetry data from the satellite whatsoever. At that point, mission controllers abandoned all attempts to recover the satellite.

Initial analysis of telemetry data acquired immediately prior to the malfunction led to an interim conclusion that a piece of debris had collided with the satellite, destroying it.

However, later examination showed a large rise in solar panel temperature as early as June 23, and decreasing power from the solar array since June 27. On August 29, the report of the technical investigative committee analyzing the cause of the failure concluded that thermal expansion of the solar array during planned full-Sun exposures exceeded design limits, and weakened the array's structural integrity.

In a July 2 NASA press release, Mike Mann, Deputy Associate Administrator, NASA's Earth Sciences Program Strategic Enterprise, said, "The failure of Japan's Advanced Earth Observing Satellite (ADEOS [or Midori]) spacecraft with the two NASA instruments aboard it is a real blow to NASA's science program."

Much of the ozone data can be obtained from another TOMS, on the Earth Probe satellite, whose orbit may be raised so it can provide similar coverage to what would have been provided by ADEOS. With this adjustment, much more complete global coverage of total ozone measurements previously provided by TOMS/ADEOS could be received. However, some of the unique, smaller scale aerosols and ozone research currently being done by TOMS/EP would be lost. The next Total Ozone Mapping Spectrometer mission is planned for launch on a Russian Meteor-3M spacecraft in 2000.

However, the excellent wind data, provided by the NSCAT, will not be so easy to replace. "The data we have obtained to date are extremely valuable," said Jim Graf, NSCAT project manager at Jet Propulsion Laboratory, in the same press release. "If we knew we were limited to just nine months of data, we would have chosen the period we actually got. We obtained coverage over the summer and winter monsoon seasons and what may be the onset of an El Niño. Perhaps the largest loss is the discontinuity of the long-term data set, which is being used to understand interannual and decadal variations in our climate."

Similarly, the data being obtained by the OCTS and POLDER instruments were just initiating a much-needed, long-term time series of measurements needed for global change studies. The successful launch of the SeaStar satellite, with the Sea-viewing Wide Field-of-View Sensor (SeaWiFS) instrument, in August 1997 should help alleviate the lack of OCTS data.

Weather forecasters at the National Oceanic and Atmospheric Administration's National Weather Service are also being affected by the loss of ADEOS ocean surface wind data products. "NOAA had begun using ocean surface wind products, derived from NSCAT, in U.S. weather forecasting. Ocean surface wind measurements are used in numerical prediction models and help forecasters more accurately determine the intensity of tropical storms and hurricanes," according to Helen Wood, Director, Office of Satellite Data Processing and Distribution, National Oceanic and Atmospheric Administration.

Despite years of experience around the globe, exploring space, and using space to explore the Earth, is still problematical, as witnessed by the recent troubles on Russia's *Mir* space station.

NASA's Mann was quick to point out that "NASDA has performed in an exemplary and open manner in the development of the spacecraft and in dealing with us." He noted that, ". . . space operations is a risky business; those of us involved in the business strive to limit the risk but sometimes mishaps do occur."

Dr. Mitchell K. Hobish

NASA's Earth Sciences Program Exhibit To Open

(Continued from page 1)

describing the Earth's systems, what data sets are (and will be) available, and how the data can be used. Open captioning will be provided. Computer-based kiosks will allow visitors to explore local and Internet-based resources for additional information, and will show short clips of interviews with scientists and engineers. A stand-alone kiosk near the exit will solicit e-mail addresses from visitors, who will then be sent an e-mail containing lists of additional resources that can be explored over the Internet from their home or office.

The NWS will be represented by its gift of a GOES real-time weather station.

Elementary and middle-school students are the primary targets for the material to be presented in the exhibit. This group makes up the greatest segment of the 50,000 visitors that travel to the Visitor Center each year.

Construction of new walls will help isolate the exhibit from existing facilities, such as the Educational Resource Center and the auditorium. In addition, there will be space and lighting for short-term exhibits in the newly formed corridor that will connect the existing north wing of the Visitor Center with the auditorium at the south end of the building.

The work is being managed by Cindy Howell, of the GSFC Public Affairs Office. The exhibit is being implemented by the current NASA HQ exhibit contractor, Design and Production, Inc., of Lorton, VA.

Dr. Mitchell K. Hobish

Saying Good-Bye to Lou Walter: A Premature Obituary

The office on the second floor of Building 16 used to be very well-organized. Actually, it's still well-organized; it's just that there are all these packing boxes scattered throughout.

Dr. Lou Walter, associate director of the Earth Sciences Directorate, Code 900, is retiring from NASA after some 35 years of service.

Lou Walter: Scientist, manager, family man. His activities at Goddard cover all these roles.

Lou Walter: Scientist

Geology was an early interest for Lou, so after schooling at the City College of New York and the University of Tennessee, and a short stint in the Navy, he went on to graduate work at Penn State, majoring in geochemistry. With an avid interest in crystal chemistry, Lou was faced with a career choice: Should he go into industry (with offers from IBM, General Electric, and Union Carbide to explore solid-state devices, or zeolites, or artificial diamond synthesis)? Or, should he take another route? The era of the Ranger moon shots and Apollo missions was coming, and he found himself wondering about research possibilities that would allow him to investigate some of the basic workings of the cosmos. Consultation with an advisor led Walter to contact Gordon J.F. MacDonald, who was then at Goddard. This contact led Lou to accept a National Research Council Resident Research Associateship in March 1961, as the only experimentalist in the Theoretical Division. "That was fun," says Lou. "Putting together equipment in an environment that had no technicians." The first time he met the Center's first Director, Harry Goett, Lou was sitting on the floor, tearing the guts out of a transformer, with grime up to his elbows.

Lou's interests in geo- and cosmochemistry became even more vital during the Apollo era, with the prospect of investigating lunar rock samples using a newly developed instrument, the electron microprobe, the ancestor of the alpha-proton X-ray spectrometer being used by the Sojourner rover on Mars.

The Geochemistry Laboratory he founded first examined meteorites and tektites, and the group became pre-eminent in the area of extraterrestrial materials. Then came the lunar samples, the refinement of techniques such as mass spectrometry, and exploration of elemental analysis for strontium/rubidium ratios, and rare earths. A strong, internationally recognized group of Lab researchers ascertained the nature and origin of these samples.

While this was a lot of fun, Lou became aware that there were many problems in the world that were potentially addressable using remote sensing, and so the Lab, which by then had become the Planetology Branch, began exploring the possibilities. Shortly thereafter, Lou was asked to be the Assistant Division Chief for Dr. William Nordberg. This corresponded with the launch of the first Earth Resources Technology Satellite (ERTS), which later became Landsat. All of a sudden, there were hundreds of principal investigators, all using Earth sciences data. The job required

integration and new tools for coordination and oversight. Part of this came under Lou's purview; the rest of the time he was busy with early Landsat satellites and Thematic Mapper instruments in his roles first as study scientist and, later, project scientist.

What had then been NASA's Applications Program—so called because it focused on how space resources could be used and justified in terms of costs and benefits—evolved into the Earth sciences program. The early promise wasn't borne out, however, as accuracies and planned and implemented uses were based on optimistic premises. However, Goddard responded with the formation of the Earth Sciences Directorate, headed by Dr. Nordberg.

Nordberg asked Lou to head the Earth Surveys Applications Division, which

included geodynamics, geology, and Earth resources. Lou is still proud of the caliber of the young Earth scientists that the Center brought on board in such diverse fields as forestry, ecology, and soils science.

As Lou sees it, "These people put Goddard on the Earth sciences map." Throughout this growth period, Lou learned more and more about the possibilities for remote sensing, and also what kinds of investigations did not lend themselves to remote sensing. For example, the early promise for geological studies was replaced by studies of vegetation and hydrology in global and environmental questions. These disciplines were key to learning and implementing appropriate use of these new technologies.

Lou saw early that the research community could no longer keep disciplines separate if we were to understand the Earth as a system. He sensed that the Earth had to be viewed as a system of many interconnected and interrelated parts. His shorthand view is that, "If you wiggle a rock here, a piece of sky falls there."

This was amply demonstrated during his involvement in the Volcano Climate Program. Work with people such as Arlen Krueger, using TOMS data to map sulfur dioxide emissions from volcanoes like El Chichon, showed that there could be global consequences from a nominally local phenomenon. And then along came the eruption of Mt. Pinatubo in 1991, and the approach was vindicated. "That kind of symbiosis has always intrigued me," says Lou, "and always will. That's the kind of approach that will allow Goddard to shine in the future."

Of perhaps more immediate significance to humans were the ways in which natural occurrences could affect them. Thus began a long-term fascination with natural hazards and the ways people respond to them.

Lou Walter: Manager

When Lou Walter sees an organizational or scientific need, he is quick to address it. Early in his role as associate director, it became clear that the project scientists in the Directorate needed some guidance as to what their responsibilities were. "I sat down with a group of them and wrote up standards for project scientists," says Lou. "Everybody sort of agreed with them, and they were taken up by the project directors." Similarly, he saw a need for a workable set of ethical guidelines for the Directorate. "So I put together a team of people and worked up an ethics statement."

He sees the same kind of need in the area of communications. Lou saw a great need to facilitate communications between groups within the Directorate to keep everyone apprised of what their colleagues are doing and how that work could affect their own. To this end, Lou has helped arrange topical conferences and symposia within the Directorate, and a Directorate mailbox for "Frequently Asked Questions."

Similarly, Lou has a strong drive in the area of outreach—providing information and material to those outside the research community to make them aware of what's happening and how it could affect them.

But, there's more: Lou has been involved with multicultural issues at Goddard, and recently led the committee that is restructuring the Center's awards process. This latter activity is particularly important, because it is a community recognition of excellence. Commenting on the quality of research done here, Lou says, "People at Goddard don't always understand just how good they are—world-class—as monitored by the number of citations which Goddard papers receive. That puts us on a par with universities like MIT and Cal Tech."

Over the last fifteen years—ever since a two-year stint with the UN's Office of Disaster Relief—Lou has been engaged in the development and use of remote sensing technology for disaster management. With the toll of disasters every high and the economic losses increasing exponentially, this field is receiving an enormous amount of attention from Federal agencies and the international community. So Lou decided to focus on this part of his career, pulling away from Goddard, and joining George Washington University's Crisis and Disaster Management Center.

Lou Walter: Family Man

Lou Walter has enjoyed a rich family life. Indeed, he claims two families: Not only does he preside over a large brood of children and grandchildren (as evidenced by the group picture he has placed prominently in his office), but he has enjoyed watching the formation and development of the Goddard family to its current prosperous state.

In the early days, Goddard was very different from what it is today. The Center was very small. Now-familiar structures were just being erected. There was only one exit, and Greenbelt Road was only two lanes wide, with five o'clock traffic jams every evening. Most of the work at Goddard was done by the men in the family, and the wives generally didn't work outside the home. Because of the isolation of the Center and the newness of people to the area, there developed a strong sense of "family." Picnics were big affairs where people had a chance to get together. Christmas parties were Centerwide, with a strong emphasis on the families, and particularly the children. "Goddard was very much a family in the early days," says Lou, "Everyone was new,

people didn't know others in the area, and there wasn't much 'area' around! So people needed an extended family."

Lou is proud and pleased with his "professional family" roles, which include his involvement in several Goddard social activities. He has a long-standing interest in the Goddard Music and Drama club, MAD, of which he was one of the founding members. With a mixture of minor and lead roles in such shows as Wonderful Town, Pajama Game, Guys and Dolls, South Pacific, and Bells Are Ringing, he has enjoyed working with other Goddard family members throughout the years in many capacities.

And when his wife, Sandy—who worked at Goddard— gave birth to their twins, he was very proud to note that their birth was announced in Dateline Goddard.

The Future

Lou is quick to emphasize that his retirement is really just a shift in activities. He is not one to sit back and watch others create new realities. After 35 years working inside the protective walls of the Government, he wants to scratch an itch: to put himself Out There, on the line, without the bullet-proof shield provided by his role as a Government representative. He wants to exercise a different part of himself, and looks forward to writing a book on the use of remote sensing and geographic information systems in disaster management. He wishes to bring such technology to a practical level, and to facilitate the extended use of remote sensing data for disaster management applications.

In the immediate future, though, he'll be taking on some academic responsibilities with a position at George Washington University. He'll also spend a year or two sitting in for Miriam Baltuck at NASA Headquarters, dealing with matters relating to natural hazards.

The Bottom Line

Echoing the sentiments of others in Code 900, Lou says, "I think my life at Goddard has provided me tremendous opportunities, and I feel immense gratitude at having had the freedom to do what I've done. I don't think there's another environment that could have afforded me such opportunities."

As for the people that support the Goddard research mission, Lou acknowledges that, "The people here are self-motivated, have vision, and are extremely bright. And with people like that around you, you just need to get out of their way."

Mostly, that's what he's done as associate director: take some heat, provide opportunities, handle some of the organizational matters that might keep others from their work, and just get out of the way. It's an approach that has worked very well.

Dr. Mitchell K. Hobish

Good Times in the Past and Exciting Time Ahead

(Continued from page 3)

— Dr. Vincent Salomonson

regard to the excellence and quality of the work done in all areas (administrative, science, technology development and application, education, and outreach), and I am sure we will then have even more to be pleased about by the time the next issue of this newsletter appears.

As always, thank you for all the good things that you do! I hope that everyone has an invigorating and uplifting holiday season and please accept my best wishes for 1998.

Earth Sciences News

The Newsletter of the Earth Sciences Directorate
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Share your news and views with your colleagues by contributing an article, photo, questions, or opinion.

Your comments are welcome, and should be directed to:
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How Does the DAAC Manage its Resources?

by Dr. Paul Chan, Distributed Active Archive Center (DAAC)

Here I will outline the framework that the DAAC uses for evaluating and managing its resources for performance. This framework is consistent with the direction articulated by the Center Director in his recent meeting with Center managers. Achieving high performance in a knowledge-based organization lies entirely in its intangible resources—people's professional competencies, resourcefulness, innovation, teamwork, and learning. While the tangible resources (e.g., hardware, facilities) depreciate, the intangible resources appreciate over time, provided that the organization successfully captures the appreciation. Hereafter, resources exclusively mean intangible resources. To ensure that the DAAC achieves high performance, I use a number of tests:

a. Do the resources contribute critically to customer benefits? To answer this question, we must know our resources and know what the customers' needs are. Instead of following a set of static requirements, the DAAC continuously attempts to capture and understand customer characteristics through various mechanisms—routinely surveying customers, soliciting feedback at conferences, and inviting scientists to our seminar series to speak about their practices. These opportunities allow us to ask probing questions of customers' desires, values, and trade-offs. Subsequently, these customer characteristics determine the way we produce products and provide services. Through these mechanisms, the DAAC continuously aligns its resources with customer benefits.

b. Are the resources superior? In other words, does the DAAC achieve the highest possible performance? But how does the DAAC evaluate itself against competitors? First, we dissect our main activity into components. Only by looking at this level of specificity can we understand whether our resources are competitively superior. For example, we compare the cost-effectiveness of data system development between the DAAC and other GSFC departments, and, externally, with other data centers.

c. Are the resources sustainable? Once resources become superior, can they stay superior. And how? Without ongoing hands-on practice, learning, and reinvestment, resources depreciate quickly. Our resources can lose superiority in two ways. First, they can become obsolete as technology advances. Second, they can be overtaken by competitors.

Performing an activity and learning from it sustain resources in the form of skills and knowledge. Learning is about asking every time we create a product or implement a data system: What did we learn the last time, and how do we do it much better the next time? At the end of every year, we publish a "report card," which documents our self-assessment and lessons learned. We are currently exploring an even more active learning mechanism.

To sustain resources, we stretch our resources to their limits—set "stretch" targets and challenge people to achieve them. For instance, the DAAC initiated many short-term projects and set stretch goals—like doubling the number of products and multiplying the number of customers five times—to force better performance. These short-term projects provided immediate results and feedback, which reinforce learning. The targets also forced the DAAC to improve some business practices. Because of these improvements, existing staff were able to handle the huge increase in customers and transactions; cycle time for data access by customers decreased 86% from 1994 to 1995; and customer complaints have dropped significantly since the last quarter of 1995. In 1995, MITRE Corporation ranked the DAAC first (ahead of Federal Express's information system) in a national benchmark study of innovative processes for data centers.

We also reinvest in our resources through training and acquiring new talent. The leverage of intangible resources is so great that a few topflight professionals can create a successful team or make a lesser one flourish. Even with the lack of compensation incentives, the DAAC is not destined to be second class. We have been rather successful in applying "jujitsu" leverage in acquiring the desired talents. Also, more than three-quarters of DAAC folks are

contractors. Treating them as peers and as an integral part of the organization—sharing visions and building competencies together—enables us to leverage their strengths toward DAAC goals.

d. Are the resources flexible? For the DAAC, flexibility means the capability to adapt to the rapidly changing environment—new customers, new customer needs, and technology advances—with speed, while maintaining quality. How rapid have changes been? For instance, since the proliferation of the World Wide Web about three years ago, the behavior of data users has changed dramatically. Also consider this: The cost of a hard disk was >$5000/GB in 1990 and it is $200/GB today. Therefore, to be flexible, our development efforts have been broken down into many small and evolutionary steps to keep pace with changes in customer behavior and technology advances.

The DAAC exhibited great flexibility in the development of the TRMM Support System (TSS). The launch-ready TSS became operational in August this year, eight months after development began. TSS, a 75 GB/day ingest, 275 GB/day distribution, and 60 TB total-archive system, has been on a fast-track and concurrent-engineering development mode (requirements and designs were continuously and systematically refined while coding was taking place). The short development cycle (< 1 year) enabled us to take advantage of the latest computer products and provided opportunities to apply the DAAC's experience and immediate lessons learned.

e. Are the resources deployed optimally? This test hinges on a number of practices that have enabled the DAAC to better utilize its resources. The first is to balance the resources, that is, remove excess resources and invest them in areas with shortages. We apply this test not only to today's resource balance, but also to anticipate future resource requirements because resources need time and investment to develop. Technology advances, organizational learning, and standardization of procedures will shift the balance by making some activities less resource intensive than others. We seek dynamic balances not only to react to changes but also to anticipate them. The second is to redeploy resources in unconventional, yet more effective, ways. In the DAAC, scientists, acting as surrogates for data users, are intimately involved in data system development from day one. The resulting system matches the user needs better and requires less rework than a system developed entirely by developers based on formal user requirements.

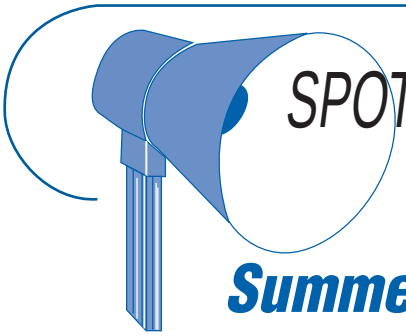
Achieving high performance derives from leveraging resources to bear on a set of selected activities. While this once meant employing a large number of people, this is no longer desirable or sufficient for today's knowledge-based organizations like GSFC. A truly sustainable and highly competitive performance usually derives from developing and deploying the intangible resources that others cannot easily duplicate or exceed.

Educational Showcase

(Pictures on page 14–16)

The Earth Sciences Directorate was well represented in Goddard's first Educational Showcase, held on October 17, 1997. The purpose of the Education Showcase was to increase employees' awareness of education programs at GSFC and of other educational resources developed by NASA GSFC for science and technology education.Twenty-four Code 900 education projects were on display in the Building 28 exhibit area. These projects represented a range of education programs and resources, including K-12 student programs, teacher enchancement opportunities, undergraduate and graduate education projects, and public education and outreach initiatives. In addition, Elissa Levine (GLOBE) and Claire Parkinson (Creating Earth Science Education Products) each gave an hour-long seminar as part of the Showcase.

The Earth Sciences Directorate wishes you all a safe and happy holiday season!



SPOTLIGHT on Education

Summer Education Activities Result in Call for More Help From Scientists

by Dr. Bob Gabrys, GSFC Education Office, Guest Writer

The Summer of '97 saw a major shift in the Maryland Ambassadors Program, which has received strong support from the Earth Sciences Directorate at GSFC for the past four years. The program shifted from one that invited a new group of teachers to be trained to one that called for curriculum support materials to be developed for use in classrooms.

The result was 43 Earth system science investigations that are now ready for field testing. The 43 investigations show direct relationships to national and Maryland state curriculum standards. National standards include not only Earth science standards, but also mathematics and geography relationships. On the science side, each investigation also shows its relationship to at least two of the following Earth system science spheres: biosphere, atmosphere, lithosphere, and hydrosphere.

The investigations were developed by teams of 3-4 teachers working with a consulting Earth scientist. They also include data from the Internet within the investigations in order to serve as a basis for using data from NASA's Earth Sciences Program launches slated during the coming years. The intent was to have teachers use GSFC Earth science data directly in the instructional process.

The investigations are now on the Web and available for use by teachers who are interested in pilot testing the materials and providing feedback for the teachers and consulting Earth scientists so that the investigations can be finalized for distribution via the Internet.

The need for help from the Earth science community now comes in two forms. One request is for scientists with expertise in one or more of the four spheres who would be willing to review the investigations for scientific accuracy and for appropriate use of Earth system science data. A second request is for assistance in identifying appropriate formats for teachers for data visualization and the development of appropriate software for such use. Assistance can come not only from the GSFC Earth scientists, but also from Principal Investigators who are funded through GSFC, as well as Earth scientists from other NASA centers. Individuals who are interested in assisting or who desire further information should contact GSFC Education Specialist, Vern Smith, at (301) 286-1977 or by e-mail at vern@aesp.nasa.okstate.edu.

Looking to the future, the GSFC Education Office is very interested in making contact with the projects that are scheduled for launch. Specific assistance would be provided in looking at the results of the missions and building the use of the data into future education plans for curriculum development and teacher training activities. The education office will assign a specialist to the project and begin to identify activities that will utilize data from the mission and awareness of the data being available to teachers for use in meeting science, mathematics, technology, and/or geography standards. Contact for this linkage can be made through Bob Gabrys at (310) 286-7205 or e-mail at bgabrys@pop100.gsfc.nasa.gov.

SeaWiFS Releases the First Global Ocean Color Data and Images

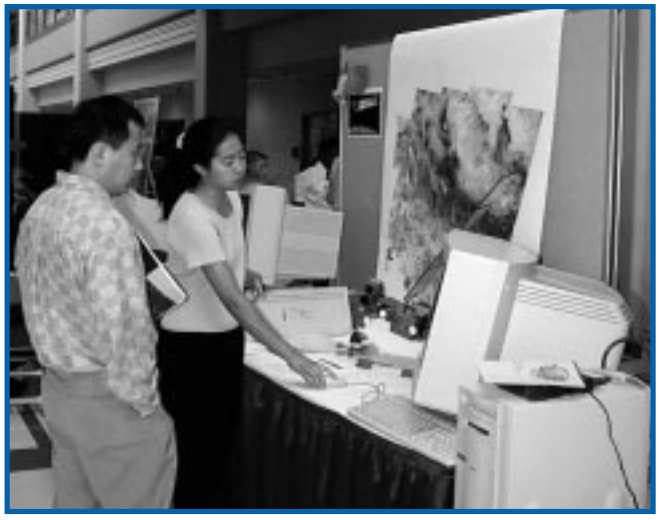
(Continued from page 2)

SeaWiFS is an essential component of NASA's Earth Sciences Program, an ongoing effort to study the changing global environment. Using the unique perspective available from space, NASA will observe, monitor, and assess large-scale environmental processes focusing on climate change.

Educational Showcase


Scientific Visualization Studio


NASA EOSDIS:
ACCESS TO EARTH SCIENCE DATA



List of Directorate Exhibits and Contacts:

Earthquake Hazard Research and Education Partnership in Alaska
Jeanne Sauber, 6-8586

MARS/MOLA Education
Stephanie Stockman, 6-3181

Seamore Project
Pam Millar, 6-3793

GGAO
Tom Clark, 6-5957

SLA Browser
Jim Roark, 6-5074

Public Use of Remote Sensing Data (RSD)
Alan Nelson, 6-2644

NASA GSFC Scientific and Educational Endeavors (SEE):Working Together To Develop Educational Materials Using NASA MTPE Data
Blanche Meeson, 4-5341

The Goddard DAAC Climatology Interdisciplinary Data Collection
Lee Kyle, 4-5352

Finding Earth Science Data on the Internet
Ron Vogel, (301) 441-4206

Glacier Bay, Alaska, from the Ground, Air and Space
Dorothy Hall, 6-6892

Remote Sensing Tutorial
Bill Dickinson, (301) 474-9696

GESSEP
Vern Smith, 6-1977 / Lisa Bernard, 6-9417

SeaWiFS
Mary Cleave, 4-1404

HoloGlobe
Barbara Summey, 6-5797

Earth System Data Visualizer
Jim Fischer, 6-3465

Minority University-SPace Interdisciplinary Network (MU-SPIN)
Carol Boquist, 6-4274

Globe Visualization
David Batchelor, 6-2988

GLOBE Program Soils Module
Christy Spector, 6-4864

Virtually Hawaii
Lori Glaze, 6-2754

Interactive website project ...remote sensing/USGS collaboration
Ginger Butcher, 6-2923

Visiting Student Enrichment Program (VSEP)
Marilyn Mack, 6-4638

Monsoons CD
Sara Tweedie, 301-933-7812

TRMM
Thomas Rickenbach, 6-1594

Dependence of precipitation on the biosphere
Greg Walker, 6-2397

Education and Outreach

EDUCATION

Dr. Elissa Levine (Code 920) participated in the 2nd International GLOBE Workshop at Airlee Center, near Warrenton, Virginia, July 21-15. The GLOBE Science Principal Investigators presented papers on the use of GLOBE student data in Earth science research. This included Dr. Levine, who presented a talk entitled "Validating a Soil Physics Model with GLOBE Student Data." In addition, results of evaluations from teachers and students in the GLOBE program were given. Although the GLOBE project is still in its early stages, it is already having great impact on the math and science education of K-12 students, international communication, and collection of important measurements for Earth system science research on a global level.

Global Change Master Directory (GCMD) representatives presented discussion-lectures on the greenhouse effect to seven teachers taking part in the NASA Education Workshop for Math and Science Technology (NEWMAST).

Goddard Institute for Space Studies (GISS, Code 940) has received two awards for education research with Medgar Evers College and City College. These are Partnership Awards through a NASA Code E program for minority institutions.

Dr. John Haberman (Code 915) was honored this year as Volunteer of the Year at G. Gardner Shugart Middle School. Dr. Haberman was instrumental in setting up a computer center, which has become an integral part of Shugart's Library Media Center. This computer lab will enable students to "step through the electronic doors to the world."

OUTREACH

Dr. Jeanne Sauber (Code 921), Stephanie Stockman (SSAI/921), and Dr. Tom Clark (Code 921) were in Alaska for a GPS field campaign, which involved the direct participation of teachers and students from five area high schools. This is a significant expansion of this involvement program over 1995, when 7 students from Kodiak High School first participated in measurements of the crustal deformation associated with the subduction process in Alaska. Grants have allowed teachers to develop individual study programs. The basic approach of this program is to educate, train, and engage students in NASA's scientific and technological enterprises by having them make the measurements, and then transfer the knowledge to the people most affected by and concerned about the earthquake hazard.

Dr. Blanche Meeson (Code 902) and Carla Evans (HSTX/902) conducted a 1/2-day introductory session on the ESP program, sensors, and data to a group of 20 educators from across the Nation, who will be testing a new "Encounter Earth" education module developed by the Challenger Center for use in their educational centers around the country.

The TRMM Office (Code 910.1) had two undergraduate students and one faculty member spend the summer working with the Office on various projects under the auspices of several NASA educational outreach programs. The participants were Dr. Donald Martin (Howard University), Mr. Brian McNoldy (Lycoming College), and Ms. Zobeida Ocasio Santiago (Metropolitan University of Puerto Rico).

Stephanie Stockman (SSAI/921) served as a judge for the National Finals of the "Mission to Mars" competition of the NASA/NSTA Space Science Student Involvement Program (SSIP) in May. She and Tom Albert (Howard county teacher with whom Stephanie has been developing curriculum materials) gave a workshop for the SSIP State Coordinators Meeting, with emphasis on the middle and high school activities Albert's students have been doing as well as teachers can expect from the current Mars Pathfinder and Global Surveyor Missions.

Dr. Cathleen Geiger (USRA/971) and her husband are volunteer tutors in mathematics this year as part of the tutoring program at Our Savior Lutheran Church in Laurel. They are working with both gifted and struggling students from grades 5-8.

The Commercial and Government Systems Group of Eastman Kodak Company is sponsoring with the Goddard DAAC a research/educational scholarship award. The amount of the award is $3,000, to be given annually for three years, to support a student to work at the DAAC for the summer to develop uses of data from the Goddard DAAC. The American Society for Photogrammetry and Remote Sensing will be responsible for selecting candidates for this award.

Did you know?

ABC News interviewed Dr. David Adamec (Code 971) on August 27 on the impacts that could be expected from the ongoing El Niño. They filmed footage covering U.S. and international impacts from El Niño's past. That evening, the El Niño story was the lead story, and some of the footage shot here was used. This footage was also rebroadcast on local news throughout the country that night. Goddard was duly noted in the broadcast.

Brian Montgomery (HSTX/922), Brent Holben (Code 923), Tom Eck (HSTX/923), and Forrest Mims and William Grant of NASA Langley published "Smokey Skies, Mosquitoes, and Disease" in the letters section of *Science*, June 20, 1997. The letter highlighted the importance of research focusing on adverse biological effects due to severe aerosol loading in the atmosphere. It also commented on possible effects on the global climate due to manmade aerosols.

The July '97 issue of *Computers and Geosciences* included a paper entitled "Time-Series Animation Techniques for Visualizing Urban Growth" by Penny Masuoka (Code 922) and William Acevedo (USGS/NASA Ames). The paper includes animations of 200 years of urban growth for the Baltimore–Washington area.

The book *Selected Papers on Optical Remote Sensing Theory and Measurements*, Dr. James A. Smith, editor, has been published as a SPIE Milestone Series (Volume MS 134). The volume is a collection of 59 "milestone papers" published over the past 30 years. The Laboratory for Terrestrial Physics/Biospheric Sciences Branch is well represented in the volume with several papers.

Dr. Arlin Krueger (Code 916) was interviewed by *USA Today* on the types of volcanic research NASA Goddard is conducting. This interview was included in an overall piece on volcanoes that appeared in the August 26 *USA Today*.

An enhanced image of hurricane Nora off Baja California, produced by Dr. Fritz Hasler, Marit Jentoft-Nilson, *et al.* (Code 912), was used by *Newsweek* magazine in their story on the effects of El Niño. The photo credit was Laboratory for Atmospheres, GSFC, with Marit's name.

Staff of the radio show "Science Report," produced by the American Institute of Physics, featuring short segments of interesting scientific results, interviewed Dr. Ben Chao (Code 926) on July 2. The topic discussed was earthquake effects on Earth rotation, especially on the rotational pole.

Dr. Ben Chao accepted an invitation to serve on the editorial board of the new international journal *Earth, Planets, and Space* (EPS). The first issue of *EPS* will be published in January 1998. *EPS* is the amalgamation of two Japanese journals: *Journal of Geomagnetism and Geoelectricity* and *Journal of Physics of the Earth*.

Dr. Anne Thompson (Code 916) has been appointed to the Climate Research Committee of the National Research Council's Commission on Geosciences, Environment, and Resources.

Mike Tierney (Code 920) received his MS in Applied Physics at Johns Hopkins University in May. This was accomplished through the Part-time Graduate Study Program.

Dr. John Degnan (Code 920) was elevated to the status of Senior Member of the IEEE in April 1997.

Sam Karki (son of Mahendra (GSC/Code 910) and Surita Karki) was awarded MVP of the year in Tennis at Longreach High School. He was also recognized with a prize and certificate for being among the top 5 percent honor roll students in his class.

Deborah Harrison (Code 916) graduated from the Baltimore School of Massage after 500 hours of training in professional massage, including the study of anatomy and physiology, and the clinical application of massage.

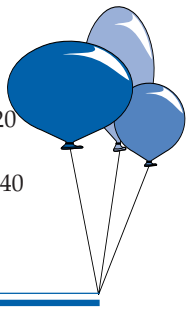
Farewells & Welcomes

Departing Employees:

Jolyn Nace/Code 970
Julianne Catloth/Code 910
Nakia Reams/Code 920
Ann Mecherikunnel/Code 920
Linda Landini/Code 903
Jonathan Rall/Code 920
Lou Walter/Code 900

New Employees:

Jeanne Raymond/Code 930
Elizabeth Rubincam/Code 920
Ifeanyi Ezeh/Code 930
Michael Mishchenko/Code 940
Leslie Nolan/Code 940



Awards:

Dr. Vincent Salomonson received an Outstanding Service Award from the IEEE Geoscience and Remote Sensing Society (GRS-S), August 5th while attending the IGARSS'97 in Singapore.

Dr. Michael King, EOS Senior Project Scientist (Code 900), was elected as a Goddard Senior Fellow.

Dr. Jack Bufton (Code 920) received the Moe I. Schneebaum Award in September 1997 in recognition of his exceptional and sustained contribution to NASA research and development in Laser Remote Sensing and Electro-optics.

Elizabeth Douglass, daughter of Dr. Anne Douglass (Code 916) is in her sophomore year at Villanova University. Last year, Elizabeth applied for and was awarded the Nancy Lorraine Jensen Memorial Scholarship for this coming year. The scholarship is to encourage women in science and engineering, and is restricted to women majoring in one of these fields. Applicants for the scholarship must either be daughters of Goddard employees or daughters of Sons of Norway. Elizabeth is majoring in physics and is the first daughter of a Goddard employee to be awarded the scholarship.

Karla M. Longo, a University of Sao Paolo graduate student, working since August at Goddard with Dr. Anne Thompson and Dr. Yoram Kaufman on analysis of SCAR-B (Smoke Clouds and Radiation-Brazil) data, was one of four people selected for an Outstanding Student Paper award for the Atmospheric Sciences Section at the Spring AGU meeting in Baltimore.

Ms. Crystal Fletcher of Eleanor Roosevelt High School, one of the Caelum Research Corporation/Mesocale Atmospheric Processes Branch (Code 912) high school interns, was chosen as a Meyerhoff Scholar and will attend the University of Maryland at Baltimore County. The Meyerhoff Scholarship is one of the most prestigous scholarships offered to UMBC students. Since the Branch started the summer intern program with local high school students in 1994, two students from the program (both mentored by Marshall Shepherd) have gone on to receive the Meyerhoff award.

Dr. Robert A. Langel, formerly of Code 920, is the recipient of the 1997 William Nordberg Memorial Award for Earth Sciences. Dr. Langel is being recognized for his internationally recognized achievements in the study of the Earth's magnetic field from space, including leadership as Project Scientist for Magsat (launched in 1979) and subsequent application of Magsat and other data to development of a new generation of geomagnetic field models, and to compilation of the first comprehensive global map of lithospheric magnetism.

Congratulations to:

Nakia Reams (Code 921) on the birth of her daughter, Kayla Rene'e Garces. Kayla was born on May 29, 1997 and weighed 7 lbs. 10 oz.

Stephen Steenrod (Code 916) and his wife Elizabeth on the birth of Camille Lorraine, born on May 12, 1997. Camille weighed 6 lbs. 2 oz.

Jim Garvin (Code 920) and his wife, Cindy, on the birth of their daughter, Danika Teagan, on June 4, 1997. Danika weighed 5 lbs. 6.5 oz.

Angela Leonard (SSAI, Code 924) on the birth of her son, Wesley James, on June 8, 1997. Wesley weighed 9 lbs. 9 oz.

Condolences to:

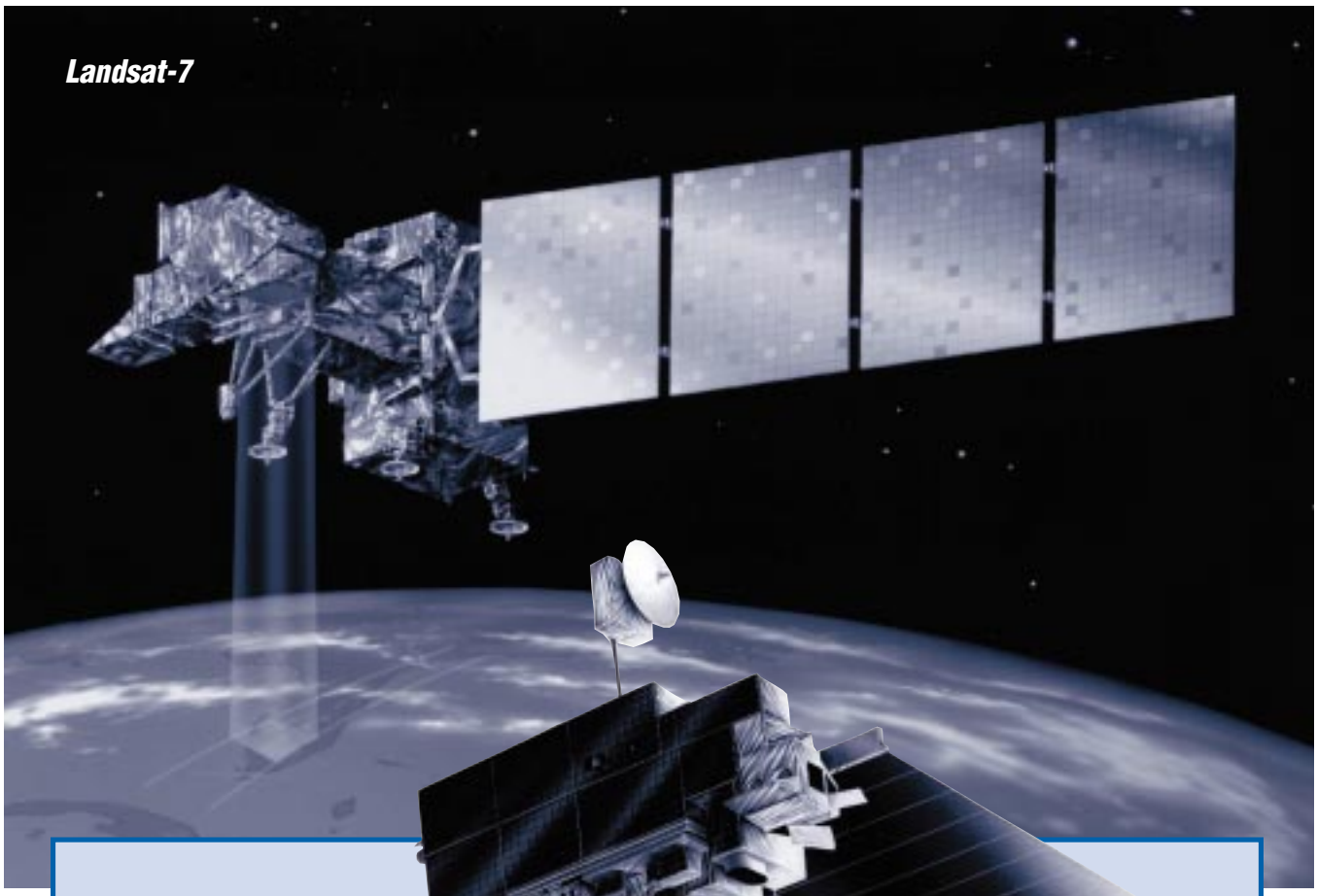
Rosemarie Givens and her family on the loss of her father in June.

Bob Rank and his family on the loss of his mother, Betty, in July.

Mary Ford and her family on the loss of her father in August.

Jacqueline Haywood and her family on the loss of her grandmother in September.

Robert Price and his family on the loss of his wife, Rosalee, in August.



Two missions are scheduled for launch over the next 12 months that have strong Code 900 connections. Landsat-7 and the Earth Observing System (EOS) AM-1 spacecraft are all due to be launched before the end of 1998. The Tropical Rainfall Measuring Mission (TRMM) was successfully launched on November 27.